ABSTRACT

Pesticide spraying is a key aspect of crop maintenance for controlling pests and diseases. Manual knapsack sprayers require the operator to exert physical effort for pumping during the spraying process. This requirement drove the design of a wheel-driven pesticide sprayer that harnesses mechanical energy from wheel rotation to power the pump. The design process followed an engineering design methodology comprising needs identification, design alternative development, design selection, component specification, mechanical system calculations, and modeling using SolidWorks. The resulting design features an 18-liter tank capacity, a piston diameter of 44.4 mm, a piston stroke length of 101 mm, and a transmission system utilizing a 22T sprocket on the wheel and a 32T sprocket on the pump. At a pushing speed of 1 m/s, the wheel rotation speed is 36.6 rpm, and the crankshaft rotation speed is 25.16 rpm. Based on these parameters, the theoretical flow rate is 3.92 L/min. Finite Element Method (FEM) analysis of the frame—modeled using ASTM A36 material and a 35 kgf load—yielded a maximum Von Mises stress of 2.812 MPa, a strain of 0.00001037 mm/mm, a maximum displacement of 0.01659 mm, and a minimum Factor of Safety of 89 (or >1); thus, under the applied loading and support conditions, the frame is deemed safe. The design demonstrates that wheel rotation can serve as a mechanical energy source to drive the pump, effectively integrating the propulsion and pumping functions into a single system that relies on neither electricity nor fuel.

Keywords: *Sprayer, Pesticide, Design, Transmission, FEM*